What is Claimed is:

1. An adaptive antenna control method used for a radio communication system built by a plurality of radio base stations and a plurality of terminal stations capable of communicating with the radio base stations, each radio base station including an adaptive antenna having a plurality of antenna elements, a distributor for generating signals to be input to the plurality of antenna elements by branching a signal of one system to be transmitted, and weighting circuits for respectively weighting transmission signals to the plurality of antenna elements, wherein

for reception by each terminal station, an interference wave power given by the transmission signal from each of the plurality of radio base stations is estimated, and

a weight in the adaptive antenna of each radio base station is determined to minimize a sum of square errors between reception signals and desired signals for all the radio base stations which simultaneously use the same communication channel.

2. A method according to claim 1, wherein a predetermined known signal is transmitted from each of the plurality of radio base stations to each terminal station, and in each terminal station, a transfer

function is obtained for each radio base station by checking a correlation between the known signal and the reception signal actually received from each radio base station, and the interference wave power is estimated on the basis of the transfer function.

3. A method according to claim 2, wherein the transfer function obtained in each terminal station is transferred to an intensive control station connected to each of the plurality of radio base stations through a wired communication line or wireless communication channel, and the intensive control station determines the weight in the adaptive antenna of each radio base station.

4. A method according to claim 2, wherein a sum result obtained by totaling, for all the antenna elements, for all the radio base stations except a station which transmits a target signal, and for the plurality of terminal stations, the interference wave powers obtained from the transfer functions obtained for the antenna elements of the radio base stations and the weights applied to the antenna elements in transmission is used as an evaluation value of the interference wave power.

5. A method according to claim 2, wherein

equation (1) representing a weight vector Wd(n) of a transmission system, which is to be given to the weighting circuit of the adaptive antenna of an nth radio base station, and equation (2) representing a gain G(m) of an mth terminal station, which is obtained by a directional pattern generated by the adaptive antenna, are alternately repeatedly calculated, and the weight vector Wd(n) of a calculation result which has converged is given to each weighting circuit:

$$\mathrm{Wd(n)} = \mathrm{G(m)}\left(\sum_{k=1}^{K} \mathrm{G(k)^2 Vd(k,n) Vd(k,n)^H}\right)^{-1} \mathrm{Vd(m,n)} \qquad \ldots (1)$$

$$\mathrm{G(m)} = \frac{\mathrm{Re(Wd(n)^H Vd(m,n))}}{\sum_{k=1}^{N} \mathrm{(Wd(k)^H Vd(m,k) Vd(m,k)^H Wd(k))} + |\sigma(\mathrm{m})|^2} \qquad \ldots (2)$$

where

σ (m): noise power of mth terminal station

Re : real number portion

suffix H: complex conjugate transposition

$$\mathrm{Wd(n)} = \begin{pmatrix} \mathrm{wd(n,1)} \\ \mathrm{wd(n,2)} \\ \vdots \\ \mathrm{wd(n,P)} \end{pmatrix}$$

wd(n,1) to wd(n,P): weights for antenna elements

P: number of antenna elements of nth base station

Vd(m,n): transfer function vector of downlink

communication between mth terminal station and nth base station

$$Vd(m,n) = \begin{pmatrix} vd(m,n,1) \\ vd(m,n,2) \\ \vdots \\ vd(m,n,P) \end{pmatrix}$$

vd(m,n,1) to vd(m,n,P): transfer functions of antenna elements

N: number of base stations

K: number of terminal stations

Assume communication between nth base station and mth terminal station

6. An adaptive antenna control method used for a radio communication system built by a plurality of radio base stations and a plurality of terminal stations capable of communicating with the radio base stations, each radio base station including an adaptive antenna having a plurality of antenna elements, weighting circuits for respectively weighting reception signals of the plurality of antenna elements, and a signal combining circuit for combining the reception signals of the antenna elements weighted by the weighting circuits, wherein

for reception by each radio base station, an interference wave power given by a transmission signal from each of the plurality of terminal stations is

estimated, and at least a weight in the adaptive antenna of each radio base station and a transmission power of each terminal station are determined to minimize a sum of square errors between reception signals and desired signals for all the terminal stations which simultaneously use the same communication channel.

7. A method according to claim 1, wherein a predetermined known signal is transmitted from each of the plurality of terminal stations to each radio base station, and in each radio base station, a transfer function is obtained for each terminal station by checking a correlation between the known signal and the reception signal actually received from each terminal station, and the interference wave power is estimated on the basis of the transfer function.

8. A method according to claim 6, wherein the transfer function obtained by each radio base station is transferred to an intensive control station connected to each of the plurality of radio base stations through a wired communication line or wireless communication channel, and the intensive control station determines the weight in the adaptive antenna of each radio base station.

9. A method according to claim 7, wherein a sum result obtained by totaling, for all the antenna elements, for all the terminal stations except a station which transmits a target signal, and for the plurality of radio base stations, the interference wave powers obtained from the transfer functions obtained for the antenna elements of the radio base stations and the weights applied to the antenna elements of a receiving station is used as an evaluation value of the interference wave power.

10. A method according to claim 7, wherein equation (3) representing a weight vector Wu(n) of a reception system, which is to be given to the weighting circuit of the adaptive antenna of an nth radio base station, and equation (4) representing a transmission power Gt(m) of an mth terminal station are alternately repeatedly calculated, and the weight vector Wu(n) of a calculation result which has converged is given to each weighting circuit:

$$\mathrm{Wu}(n) = \mathrm{Gt}(m)\left(\sum_{k=1}^{K} \mathrm{Gt}(k)^2 \mathrm{Vu}(k,n)\mathrm{Vu}(k,n)^H\right)^{-1} \mathrm{Vu}(m,n) \qquad \ldots (3)$$

$$\mathrm{Gt}(m) = \frac{\mathrm{Re}(\mathrm{Wu}(n)^H \mathrm{Vu}(m,n))}{\sum_{k=1}^{N}(\mathrm{Wu}(k)^H \mathrm{Vu}(m,k)\mathrm{Vu}(m,k)^H \mathrm{Wu}(k)) + (\mathrm{Wu}(n)^H \mathrm{Wu}(n)|\sigma(m)|^2)} \qquad \ldots (4)$$

where

$\sigma(n)$: input noise power of nth base station

Wu(n): weight vector of nth adaptive antenna system

Re : real number portion

suffix H: complex conjugate transposition

$$Wu(n) = \begin{pmatrix} wu(n,1) \\ wu(n,2) \\ \vdots \\ wu(n,P) \end{pmatrix}$$

wu(n,1) to wu(n,P): weights for antenna elements

P: number of antenna elements of nth base station

Vu(m,n): transfer function vector of uplink communication between mth terminal station and nth base station

$$Vu(m,n) = \begin{pmatrix} vu(m,n,1) \\ vu(m,n,2) \\ \vdots \\ vu(m,n,P) \end{pmatrix}$$

vu(m,n,1) to vu(m,n,P): transfer functions of antenna elements

N: number of base stations

K: number of terminal stations

Assume communication between nth base station and mth terminal station

11. An adaptive antenna transmission/reception characteristic control method wherein

when a plurality of terminal stations are present in a radio zone where a plurality of radio base stations each having an antenna are present, and at least two of the plurality of terminal stations are transmitting/receiving radio wave signals to/from different radio base stations using the same communication channel with the same signal transmission/reception frequency and same signal transmission/reception timing, at least one of a transmission signal from each of the terminal stations and a reception signal at each of the terminal stations, which is received by and transmitted from each of the terminal stations, is received through the plurality of radio base stations, and

a directivity characteristic of the antenna of each base station is changed on the basis of the received signals to reduce an interference power between the terminal stations.

12. A method according to claim 11, wherein

the transmission/reception signals of the terminal stations using the same communication channel, which are received through the radio base station, are transferred to an intensive control station, and

the intensive control station generates, on

the basis of the transferred signals, a control signal for reducing the interference power between the terminal stations and transmits the control signal to each radio base station, thereby changing the directivity characteristic of the antenna of each radio base station.

13. A method according to claim 12, wherein the intensive control station obtains a field strength and spatial correlation characteristic of each radio base station on the basis of the transferred signals and, on the basis of the obtained field strength and spatial correlation characteristic, determines a base station whose directivity characteristic of the antenna is to be changed.

14. A method according to claim 11, wherein each radio base station having an adaptive antenna comprising the antenna formed from a plurality of antenna elements and weighting circuits for respectively weighting transmission/reception signals of the plurality of antenna elements, and the weighting circuits weight the transmission/reception signals transmitted/received from/by the plurality of antenna elements, thereby changing the directivity characteristic of the antenna.

15. A method according to claim 14, wherein upon receiving signals transmitted from the

plurality of neighboring radio base stations, each terminal station estimates a transfer function by checking a correlation between each of the reception signals and a known signal which is held by the terminal station in advance and transmits the transfer function to the radio base station, and

each radio base station changes the directivity characteristic of the antenna on the basis of the received transfer function.

16. A method according to claim 15, wherein

each radio base station transmits to the intensive control station the transfer function transmitted from each terminal station, and

the intensive control station calculates a weight vector Wd(i) (i = 1 to n: n is the total number of terminal stations), using as parameters, the transfer function and a predicted value 1/G(i) (i = 1 to n: n is the total number of terminal stations) of a reception level of each terminal station,

on the basis of the calculated weight vector Wd(i), calculates a sum of square errors between the reception signals at the terminal stations which simultaneously use the same communication channel with the same frequency and same timing and desired signals corresponding to the reception signals and repeatedly calculates the weight vector Wd(i) while repeatedly

changing the parameters until the sum of the square errors becomes smaller than a predetermined threshold value, and

determines the weight of the antenna of each radio base station on the basis of the weight vector Wd(i) obtained when the sum of the square errors becomes smaller than the threshold value.

17. A method according to claim 15, wherein

each radio base station transmits to the intensive control station the transfer function transmitted from each terminal station, and

the intensive control station calculates a weight vector Wd(i) (i = 1 to n: n is the total number of terminal stations), using as parameters, the transfer function and a predicted value 1/G(i) (i = 1 to n: n is the total number of terminal stations) of a reception level of each terminal station,

on the basis of the calculated weight vector Wd(i), calculates a sum of square errors between the reception signals at the terminal stations which simultaneously use the same communication channel with the same frequency and same timing and desired signals corresponding to the reception signals and repeatedly calculates the weight vector Wd(i) while repeatedly changing the parameters until a maximum value of the square errors at each terminal station becomes smaller

than a predetermined threshold value, and

determines the weight of the antenna of each radio base station on the basis of the weight vector Wd(i) obtained when the maximum value of the square errors becomes smaller than the threshold value.

18. A method according to claim 16, wherein equation (5) representing a weight vector Wd(n) of a transmission system, which is to be given to the weighting circuit of the adaptive antenna of an nth radio base station, and equation (6) representing a predicted value 1/G(m) of the reception level of an mth terminal station, which is obtained by a directional pattern generated by the adaptive antenna, are alternately repeatedly calculated, and the weight vector Wd(n) of a calculation result which has converged is used as a value of the weight to be given to each weighting circuit:

$$\mathrm{Wd}(n) = G(m)\left(\sum_{k=1}^{K} G(k)^2 \mathrm{Vd}(k,n)\mathrm{Vd}(k,n)^H\right)^{-1} \mathrm{Vd}(m,n) \qquad \ldots (5)$$

$$G(m) = \frac{\mathrm{Re}(\mathrm{Wd}(n)^H \mathrm{Vd}(m,n))}{\sum_{k=1}^{N} (\mathrm{Wd}(k)^H \mathrm{Vd}(m,k)\mathrm{Vd}(m,k)^H \mathrm{Wd}(k)) + |\sigma(m)|^2} \qquad \ldots (6)$$

where

σ (m): noise power of mth terminal station

Re : real number portion

suffix H: complex conjugate transposition

$$Wd(n) = \begin{pmatrix} wd(n,1) \\ wd(n,2) \\ \vdots \\ wd(n,P) \end{pmatrix}$$

wd(n,1) to wd(n,P): weights for antenna elements

P: number of antenna elements of nth base station

Vd(m,n): transfer function vector of downlink communication between mth terminal station and nth base station

$$Vd(m,n) = \begin{pmatrix} vd(m,n,1) \\ vd(m,n,2) \\ \vdots \\ vd(m,n,P) \end{pmatrix}$$

vd(m,n,1) to vd(m,n,P): transfer functions of antenna elements

N: number of base stations

K: number of terminal stations

Assume communication between nth base station and mth terminal station

19. A method according to claim 17, wherein equation (7) representing a weight vector Wd(n) of a transmission system, which is to be given to the weighting circuit of the adaptive antenna of an nth radio base station, and equation (8) representing a

predicted value 1/G(m) of the reception level of an mth terminal station, which is obtained by a directional pattern generated by the adaptive antenna, are alternately repeatedly calculated, and the weight vector Wd(n) of a calculation result which has converged is used as a value of the weight to be given to each weighting circuit:

$$Wd(n) = G(m)\left(\sum_{k=1}^{K} G(k)^2 Vd(k,n) Vd(k,n)^H\right)^{-1} Vd(m,n) \qquad \ldots (7)$$

$$G(m) = \frac{\mathrm{Re}(Wd(n)^H Vd(m,n))}{\sum_{k=1}^{N} (Wd(k)^H Vd(m,k) Vd(m,k)^H Wd(k)) + |\sigma(m)|^2} \qquad \ldots (8)$$

where

σ (m): noise power of mth terminal station

Re : real number portion

suffix H: complex conjugate transposition

$$Wd(n) = \begin{pmatrix} wd(n,1) \\ wd(n,2) \\ \vdots \\ wd(n,P) \end{pmatrix}$$

wd(n,1) to wd(n,P): weights for antenna elements

P: number of antenna elements of nth base station

Vd(m,n): transfer function vector of downlink communication between mth terminal station and nth base station

$$Vd(m,n) = \begin{pmatrix} vd(m,n,1) \\ vd(m,n,2) \\ \vdots \\ vd(m,n,P) \end{pmatrix}$$

vd(m,n,1) to vd(m,n,P): transfer functions of antenna elements

N: number of base stations

K: number of terminal stations

Assume communication between nth base station and mth terminal station

20. A method according to claim 14, wherein

upon receiving signals transmitted from the plurality of neighboring terminal stations, each radio base station estimates a transfer function by checking a correlation between each of the reception signals and a known signal which is held by the radio base station in advance and changes the directivity characteristic of the antenna of the radio base station on the basis of the transfer function.

21. A method according to claim 20, wherein

each radio base station transmits the transfer function to the intensive control station, and

the intensive control station calculates a weight vector Wu(i) (i = 1 to n: n is the total number of terminal stations), using as parameters, the transfer

function and a transmission power value G(i) (i = 1 to n: n is the total number of terminal stations) set for each terminal station,

on the basis of the calculated weight vector Wu(i), calculates a sum of square errors between the transmission signals at the terminal stations which simultaneously use the same communication channel with the same frequency and same timing and desired signals corresponding to the transmission signals and repeatedly calculates the weight vector Wu(i) while repeatedly changing the parameters until the sum of the square errors becomes smaller than a predetermined threshold value, and

determines the weight of the antenna of each radio base station on the basis of the weight vector Wu(i) obtained when the sum of the square errors becomes smaller than the threshold value.

22. A method according to claim 20, wherein

each radio base station transmits the transfer function to the intensive control station, and

the intensive control station calculates a weight vector Wu(i) (i = 1 to n: n is the total number of terminal stations), using as parameters, the transfer function and a transmission power value G(i) (i = 1 to n: n is the total number of terminal stations) set for each terminal station,

on the basis of the calculated weight vector Wu(i), calculates a sum of square errors between the transmission signals at the terminal stations which simultaneously use the same communication channel with the same frequency and same timing and desired signals corresponding to the transmission signals and repeatedly calculates the weight vector Wu(i) while repeatedly changing the parameters until a maximum value of the square errors at each terminal station becomes smaller than a predetermined threshold value, and

determines the weight of the antenna of each radio base station on the basis of the weight vector Wu(i) obtained when the maximum value of the square errors becomes smaller than the threshold value.

23. A method according to claim 21, wherein equation (9) representing a weight vector Wu(n) of a reception system, which is to be given to the weighting circuit of the adaptive antenna of an nth radio base station, and equation (10) representing a transmission power Gt(m) of an mth terminal station are alternately repeatedly calculated, and the weight vector Wu(n) of a calculation result which has converged is used as a weight to be given to each weighting circuit:

$$Wu(n) = Gt(m)\left(\sum_{k=1}^{K} Gt(k)^2 Vu(k,n)Vu(k,n)^H\right)^{-1} Vu(m,n) \qquad \ldots(3)$$

$$Gt(m) = \frac{\mathrm{Re}(Wu(n)^H Vu(m,n))}{\sum_{k=1}^{N}(Wu(k)^H Vu(m,k) Vu(m,k)^H Wu(k)) + (Wu(n)^H Wu(n)|\sigma(m)|^2)} \quad \ldots (4)$$

where

$\sigma(n)$: input noise power of nth base station

Wu(n): weight vector of nth adaptive antenna system

Re : real number portion

suffix H: complex conjugate transposition

$$Wu(n) = \begin{pmatrix} wu(n,1) \\ wu(n,2) \\ \vdots \\ wu(n,P) \end{pmatrix}$$

wu(n,1) to wu(n,P): weights for antenna elements

P: number of antenna elements of nth base station

Vu(m,n): transfer function vector of uplink communication between mth terminal station and nth base station

$$Vu(m,n) = \begin{pmatrix} vu(m,n,1) \\ vu(m,n,2) \\ \vdots \\ vu(m,n,P) \end{pmatrix}$$

vu(m,n,1) to vu(m,n,P): transfer functions of antenna elements

N: number of base stations

K: number of terminal stations

Assume communication between nth base station and mth terminal station

24. A method according to claim 22, wherein equation (11) representing a weight vector Wu(n) of a reception system, which is to be given to the weighting circuit of the adaptive antenna of an nth radio base station, and equation (12) representing a transmission power Gt(m) of an mth terminal station are alternately repeatedly calculated, and the weight vector Wu(n) of a calculation result which has converged is used as a weight to be given to each weighting circuit:

$$\mathrm{Wu(n)} = \mathrm{Gt(m)}\left(\sum_{k=1}^{K} \mathrm{Gt(k)}^2 \mathrm{Vu(k,n)} \mathrm{Vu(k,n)}^H\right)^{-1} \mathrm{Vu(m,n)} \qquad \ldots (3)$$

$$\mathrm{Gt(m)} = \frac{\mathrm{Re}(\mathrm{Wu(n)}^H \mathrm{Vu(m,n)})}{\sum_{k=1}^{N} (\mathrm{Wu(k)}^H \mathrm{Vu(m,k)} \mathrm{Vu(m,k)}^H \mathrm{Wu(k)}) + (\mathrm{Wu(n)}^H \mathrm{Wu(n)} |\sigma(\mathrm{m})|^2)} \qquad \ldots (4)$$

where

σ (n): input noise power of nth base station

Wu(n): weight vector of nth adaptive antenna system

Re : real number portion

suffix H: complex conjugate transposition

$$Wu(n) = \begin{pmatrix} wu(n,1) \\ wu(n,2) \\ \vdots \\ wu(n,P) \end{pmatrix}$$

wu(n,1) to wu(n,P): weights for antenna elements

P: number of antenna elements of nth base station

Vu(m,n): transfer function vector of uplink communication between mth terminal station and nth base station

$$Vu(m,n) = \begin{pmatrix} vu(m,n,1) \\ vu(m,n,2) \\ \vdots \\ vu(m,n,P) \end{pmatrix}$$

vu(m,n,1) to vu(m,n,P): transfer functions of antenna elements

N: number of base stations

K: number of terminal stations

Assume communication between nth base station and mth terminal station